

REMARKS

Reconsideration and allowance of this application, as amended, is respectfully requested.

This amendment is in response to the Office Action dated January 29, 2003.

By the present amendment, the Title and Specification have been amended to respond to the objections set forth on page 2 of the Office Action. Therefore, removal of these objections is respectfully requested.

By the attached drawing change authorization request, figures 31 and 32 have been labeled as prior art. Accordingly, removal of the objection regarding this point on page 2 of the Office Action is also respectfully requested.

In addition, new formal drawings are submitted herewith. It is noted that these drawings do not contain any foreign characters. Accordingly, removal of the objection set forth in the Office Action bridging page 2 and 3 is also respectfully requested.

In addition, the original claims 12 and 23-34 have been cancelled, without prejudice, and new claims 35-50 are submitted for examination.

~~Briefly, the invention as defined by newly submitted claims 35-50 is directed to~~
an improved semiconductor apparatus including a semiconductor device and an electrically insulating layer having an inclined portion formed on the semiconductor device (e.g. such as indicated by the numeral 5 in various figures of the present application.) An external connection (e.g. such as indicated by the numeral 1 in the drawings) and a wiring (e.g. such as indicated by the numeral 4 in the drawings) are formed in conjunction with the electrically insulating layer having an inclined portion. Beyond this, the insulating layer includes a protrusive portion which is higher than a

height of a flat portion near a boundary between the inclined portion and the flat portion. In particular, as described on page 31, line 9 et seq.:

"Further, a protrusive portion which is formed intentionally in the stress relaxation layer 5 as shown in Fig. 1 affords a flexible portion along the wiring 4. Thus, the aforementioned structure can effectively absorb the stress induced by thermal expansion, etc. so that the wiring 4 can be prevented more greatly from being disconnected."

In conjunction with this, a part of the wiring is formed on the protrusive portion, as shown in Fig. 1, and the wiring is comprised of a copper layer in a nickel layer formed on the copper layer, as set forth in the independent claims 35, 49 and 50.

Reconsideration and allowance of independent claims new claims 35-50 over the cited prior art to Shimoishizaka (USP 6,313,532), whether considered alone or in combination with the other cited prior art Kanbey (USP 6,323,439), Yokota (JP Patent 363200415), Iwatsu (USP 6425516) or Kameda (USP 6130484), is respectfully requested. As discussed above, each of the independent claims 35, 49 and 50 contain a specific limitation of an insulating layer having a protrusive portion with a height higher than a flat portion or the insulating layer having substantial uniform thickness adjacent thereto. ~~This feature is in combination with limitations~~ defining that a part of the wiring is formed on the protrusive portion and that the wiring comprises a copper layer and a nickel layer formed on the copper layer. As such, each of the independent claims 35, 49 and 50 defines a combination which serves to prevent breakage of the wiring in the overall structure, thereby greatly improving reliability of the device.

Neither the primary reference to Shimoishizaka nor any of the cited secondary references teach or suggest this claim structure with the combination of the insulating layer having the protrusive portion in combination with forming a portion of

the wiring on the protrusive portion wherein the wiring comprises a copper layer with a nickel layer formed on the copper layer. As such, the cited references lack this important structural combination set forth in each of the independent claims. As a result, neither the cited primary reference nor the secondary cited references will achieve the advantages of the combined structure of the protrusive portion and the specific wiring layer to achieve the advantages of the reduced breakage and disconnection and higher reliability in the claimed apparatus. Therefore, reconsideration and allowance of independent claims 35, 49 and 50 over the cited prior art is respectfully requested.

Consideration and allowance of the dependent claims 36-48 is also respectfully requested. These claims, all dependent on claim 35, define further distinguishing features, which, when considered in combination with the features of claims 35, are clearly completely unsuggested by the cited prior art. For example, referring to claim 39, the feature is defined that, when a copper layer is deformed subject to deformation of the electrically insulating film, the nickel layer serves to restore the copper to its original shape before deformation. This is discussed, for example, on page 47 and 48 of the specification. This feature is completely lacking from the cited references.

Dependent claim 40 (as well as independent claims 49 and 50) defines the feature of the electrically insulating layer being formed by printing using a mask. As shown from the attached sketch, when a mask is released after an electrically insulating material is printed by the use of a mask according to the present invention, the edge of the insulating material is pulled out over the surface tension and then overflows, or inclines, so that a protrusive portion is formed. In this manner, the protrusive portion is formed actively by the manufacturing method using mask

printing. In addition, an insulating layer having a desired thickness can be formed in one process, without the need for photolithography. This is describe, for example, on page 30, lines 10-26 of the specification. Again, the cited references fail to teach or suggest this feature.

Dependent claim 41 defines the feature of the electrically insulating layer including particles. By virtue of including particles, the viscosity of the formation controllability of the insulating layer can be adjusted, as can the inclination angle. The cited primary reference to Shimoishizaka fails to teach or suggest this feature, and, as such, does not have these advantages. These features are discussed incidentally, on pages 29 and 30 of the specification, and serve to further distinguish claim 41 over the cited prior art.

Dependent claim 42 defines a range of thickness for the insulating layer between 35 and 150 micrometers. By virtue of this, alpha rays from an external terminal can be prevented from adversely effecting the semiconductor apparatus, as discussed on pages 58-61 of the specification. The cited prior art discloses the use of an electrical insulating layer (e.g. a stress relaxation layer) having a thickness in a broader range of between 10 and 150 micrometers. However, the cited prior art, such as the primary reference to Shimoishizaka, fails to disclose that alpha rays occurring from a bump can be prevented. Accordingly, the cited references fail to recognize the advantage of the particular claimed range, which is especially evident noting that this problem can occur at the lower end of the range set forth, for example, in the cited prior art, for example, at 20 micormeters.

Claims 35 and 50 define the wiring further including a Cr layer between the electrical insulating layer and the Cu layer. Further, the thickness range is set forth between 75 nanometers to 0.5 micrometers. By virtue of this, adhesion can be

improved. This is discussed, for example, on pages 35-37 of the specification, and is completely lacking from the cited art.

Claim 46 defines a feature of an external connection terminal having a first external connection formed on a flat portion of the insulating layer and a second external portion formed on the inclined portion. This serves to reduce the size of the apparatus having multiple terminals, and is discussed, for example, on pages 66 and 67. None of the cited prior art teaches or suggests this specific feature.

Claim 47 defines the feature of the external connection terminal having a first external connection terminal formed near the center of the insulating layer and a second external terminal formed outwardly from the center. When the apparatus is mounted on a substrate, a contact angle between the first external terminal and the insulating layer is smaller than a contact layer between the second external terminal and the insulating layer. As the contact angle is increased, the concentration of stress is relaxed at the connection portion between the external connection terminal and the pad. This serves to prevent cracking around the external connection. This is discussed, for example, on page 28, lines 5-21 of the specification, and, again is lacking from the cited prior art.

With regard to dependent claim 48, this claims defines that some of the external connection terminals near the outer circumference of the insulating layer are not electrically connected to the wiring. As such, the external connection terminal near the out circumference can be used as a cushioning material. This serves to prevent cracking from an external force, thereby improving reliability of the bonding to the external connection terminals formed inside the device. This is discussed, for example, on pages 71 and 72 of the specification, and is lacking from the cited prior art.

For the reasons set for above, it is respectfully submitted that all of newly submitted claims 35-50 clearly define over the cited prior art, and reconsideration and allowance of these claims is respectfully requested.

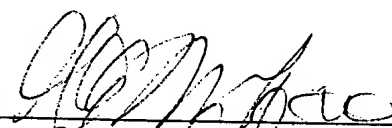
If the Examiner believes that there are any other points which may be clarified or otherwise disposed of either by telephone discussion or by personal interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The changes are shown on the attached pages, the first page of which is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 501.339241X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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Attachments: Sketch
Version With Markings To Show Changes Made

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

Please amend the title as follows:

SEMICONDUCTOR DEVICE APPARATUS INCLUDING INSULATING LAYER
HAVING A PROTRUSIVE PORTION

IN THE SPECIFICATION:

Please replace the paragraph following the heading CROSS-REFERENCE TO RELATED APPLICATIONS with the following new paragraph:

The present application is related to application serial number 09/698,186 filed by K. Inoue and eleven others corresponding to Japanese Patent Application No. 11-307986 filed October 29, 1999 and Japanese Patent Application Nos. 2000-134209, 2000-134210 and 2000-134211 all of the three filed April 28, 2000, the content of which is incorporated herein by reference in its entirety, and is also related to application serial number 09/698,185 filed by K. Inoue and eleven others corresponding to Japanese Patent Application No. 11-307986 filed October 29, 1999 and Japanese Patent Application No. 2000-134214 filed April 28, 2000, the content of which is also incorporated herein by reference in its entirety.